



Entraînement - Training

INSTRUCTION : English version below

En haut de chaque page se trouvent 3 nombres, par exemple +1/3/58+. Vous **devez** vérifier que, sur chacune des pages de votre sujet, le **premier** de ces 3 nombres est le même (dans cet exemple, il s'agit donc du 1). Ce nombre identifie votre copie. Les deux autres nombres ne sont pas importants.

Détacher la dernière feuille et répondre dessus. Ne pas rendre les pages contenant les questions, vous ne devez rendre **que la dernière feuille**. Chaque question est sur 1 point, aucun point ne sera attribué aux questions contenant une mauvaise réponse.

Les questions faisant apparaître le symbole ♣ peuvent présenter une ou plusieurs bonnes réponses qui doivent toutes être cochées. Les autres ont une unique bonne réponse.

At the top of each page are written 3 numbers, +1/3/58+. You **must** check that, on each page you have, the **first** number is the same (in this case, it would be the number 1). This number is the id of your subject. The two other numbers are not important.

Answer only on the last page. Keep the other pages containing the questions, you just have to return **the last page**. Each right answer gives you 1 point. For any wrong answer, the mark of the question is 0.

If there is a question with a symbol ♣, there may be one or more right answer. All of them must be checked. Any other question has only one right answer.

Question 1

6 jobs must be executed on a machine M_1 then on a machine M_2 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6
M_1	50	180	190	80	210	30
M_2	60	240	230	90	140	100

Check the order that could be returned by the Johnson algorithm.

- | | | | | |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|
| ☐ 1 125436 | ☐ 3 513624 | ☐ 5 463215 | ☐ 7 241635 | ☐ 9 614235 |
| ☐ 2 623154 | ☐ 4 135642 | ☐ 6 642513 | ☐ 8 462153 | ☐ 10 125634 |



Question 2

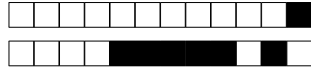
6 jobs must be executed on a machine M_1 then on a machine M_2 and finally on a machine M_3 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . Similarly for M_3 . The durations of the jobs on the three machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6
M_1	160	150	190	230	110	60
M_2	60	30	60	20	20	50
M_3	190	220	160	130	180	200

Parmi les ordres suivants, lequel correspond à un résultat que pourrait renvoyer l'algorithme de Johnson adapté au cas de 3 machines? Si cet algorithme n'est pas adapté au cas de 3 machines, cochez la case "Err".

Check the order that could be returned by the Johnson algorithm, if this algorithm is suitable for this case. Otherwise, check "Err".

- | | | | | |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|
| ☐ 1 Err | ☐ 3 451362 | ☐ 5 563412 | ☐ 7 146253 | ☐ 9 312546 |
| ☐ 2 162534 | ☐ 4 341562 | ☐ 6 531642 | ☐ 8 321546 | ☐ 10 652134 |



Question 3

8 jobs must be executed on a machine M_1 then on a machine M_2 , in **any** order. A job can be executed on one machine at a time, and a machine can execute only one job at the same time. The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7	j_8
M_1	1630	260	190	240	160	220	260	260
M_2	760	10	60	20	170	210	220	30

What is the minimum time we need to execute all the jobs on the machines?

- | | | | | | | | | | |
|----------------------------|------|----------------------------|------|----------------------------|------|----------------------------|------|-----------------------------|------|
| ☐ 1 | 3310 | ☐ 3 | 2680 | ☐ 5 | 1680 | ☐ 7 | 2390 | ☐ 9 | 1480 |
| ☐ 2 | 2010 | ☐ 4 | 3220 | ☐ 6 | 2870 | ☐ 8 | 1880 | ☐ 10 | 2410 |



Question 4

6 jobs must be executed on a machine M_1 then on a machine M_2 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6
M_1	180	50	90	240	140	220
M_2	60	160	160	40	170	210

Check the order that could be returned by the Johnson algorithm.

- | | | | | |
|--|--|--|--|---|
| 1 543126 | 3 235614 | 5 261354 | 7 362145 | 9 162534 |
| 2 624153 | 4 432165 | 6 453126 | 8 326514 | 10 246531 |

**Question 5**

8 jobs must be executed on a machine M_1 then on a machine M_2 and finally on a machine M_3 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . Similarly for M_3 . The durations of the jobs on the three machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7	j_8
M_1	190	130	270	320	310	90	190	310
M_2	60	30	30	40	30	30	80	70
M_3	200	80	250	230	250	140	120	290

Parmi les ordres suivants, lequel correspond à un résultat que pourrait renvoyer l'algorithme de Johnson adapté au cas de 3 machines? Si cet algorithme n'est pas adapté au cas de 3 machines, cochez la case "Err".

Check the order that could be returned by the Johnson algorithm, if this algorithm is suitable for this case. Otherwise, check "Err".

- | | | | | |
|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|
| ☐ 1 Err | ☐ 3 82546371 | ☐ 5 51627438 | ☐ 7 62184735 | ☐ 9 56738412 |
| ☐ 2 75614328 | ☐ 4 87215364 | ☐ 6 53427186 | ☐ 8 63154827 | ☐ 10 61835472 |



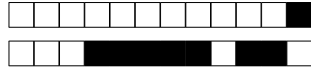
Question 6

6 jobs must be executed on a machine M_1 then on a machine M_2 , in **any** order. A job can be executed on one machine at a time, and a machine can execute only one job at the same time. The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6
M_1	200	220	40	160	200	60
M_2	200	20	140	60	160	10

What is the minimum time we need to execute all the jobs on the machines?

- | | | | | |
|--------------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|
| ☐ 1 480 | ☐ 3 400 | ☐ 5 760 | ☐ 7 310 | ☐ 9 880 |
| ☐ 2 630 | ☐ 4 700 | ☐ 6 390 | ☐ 8 590 | ☐ 10 740 |



Question 7

6 jobs must be executed on a machine M_1 then on a machine M_2 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6
M_1	170	10	50	20	20	180
M_2	110	220	90	240	60	160

Check the order that could be returned by the Johnson algorithm.

- | | | | | |
|---------------------|---------------------|---------------------|---------------------|----------------------|
| <div>1</div> 234561 | <div>3</div> 142536 | <div>5</div> 231465 | <div>7</div> 461352 | <div>9</div> 314265 |
| <div>2</div> 324651 | <div>4</div> 361254 | <div>6</div> 542631 | <div>8</div> 624315 | <div>10</div> 245361 |

**Question 8**

7 jobs must be executed on a machine M_1 then on a machine M_2 and finally on a machine M_3 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . Similarly for M_3 . The durations of the jobs on the three machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7
M_1	90	270	130	90	120	240	110
M_2	70	10	60	10	10	30	60
M_3	150	150	230	160	130	80	260

Parmi les ordres suivants, lequel correspond à un résultat que pourrait renvoyer l'algorithme de Johnson adapté au cas de 3 machines? Si cet algorithme n'est pas adapté au cas de 3 machines, cochez la case "Err".

Check the order that could be returned by the Johnson algorithm, if this algorithm is suitable for this case. Otherwise, check "Err".

- | | | | | |
|------------------------------------|------------------------------------|------------------------------------|------------------------------------|-------------------------------------|
| ☐ 1 Err | ☐ 3 4173652 | ☐ 5 1723645 | ☐ 7 4537126 | ☐ 9 1347265 |
| ☐ 2 3251647 | ☐ 4 3612754 | ☐ 6 4517326 | ☐ 8 5327461 | ☐ 10 1372465 |



Question 9

8 jobs must be executed on a machine M_1 then on a machine M_2 , in **any** order. A job can be executed on one machine at a time, and a machine can execute only one job at the same time. The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7	j_8
M_1	140	870	230	20	250	50	20	160
M_2	280	1160	20	240	230	40	100	240

What is the minimum time we need to execute all the jobs on the machines?

- | | | | | |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|
| ☐ 1 1940 | ☐ 3 1960 | ☐ 5 1830 | ☐ 7 1910 | ☐ 9 2030 |
| ☐ 2 2260 | ☐ 4 2310 | ☐ 6 2230 | ☐ 8 1670 | ☐ 10 1740 |



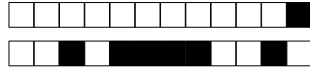
Question 10

5 jobs must be executed on a machine M_1 then on a machine M_2 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5
M_1	50	20	150	50	190
M_2	160	130	90	20	110

Check the order that could be returned by the Johnson algorithm.

- | | | | | |
|--------------------|--------------------|--------------------|--------------------|---------------------|
| <div>1</div> 12435 | <div>3</div> 53124 | <div>5</div> 54321 | <div>7</div> 21534 | <div>9</div> 23145 |
| <div>2</div> 51243 | <div>4</div> 21543 | <div>6</div> 21435 | <div>8</div> 43251 | <div>10</div> 12543 |

**Question 11**

8 jobs must be executed on a machine M_1 then on a machine M_2 and finally on a machine M_3 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . Similarly for M_3 . The durations of the jobs on the three machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7	j_8
M_1	140	320	210	140	190	300	160	180
M_2	80	80	70	30	20	40	10	30
M_3	170	150	80	90	150	240	250	320

Parmi les ordres suivants, lequel correspond à un résultat que pourrait renvoyer l'algorithme de Johnson adapté au cas de 3 machines? Si cet algorithme n'est pas adapté au cas de 3 machines, cochez la case "Err".

Check the order that could be returned by the Johnson algorithm, if this algorithm is suitable for this case. Otherwise, check "Err".

- | | | | | |
|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|
| ☐ 1 Err | ☐ 3 67238514 | ☐ 5 61487235 | ☐ 7 52348176 | ☐ 9 64815327 |
| ☐ 2 81726354 | ☐ 4 64735182 | ☐ 6 46215378 | ☐ 8 78162534 | ☐ 10 42513687 |



Question 12

7 jobs must be executed on a machine M_1 then on a machine M_2 , in **any** order. A job can be executed on one machine at a time, and a machine can execute only one job at the same time. The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7
M_1	90	20	110	240	120	10	280
M_2	220	20	50	40	140	40	220

What is the minimum time we need to execute all the jobs on the machines?

- | | | | | |
|--------------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|
| ☐ 1 500 | ☐ 3 730 | ☐ 5 530 | ☐ 7 480 | ☐ 9 710 |
| ☐ 2 400 | ☐ 4 880 | ☐ 6 890 | ☐ 8 870 | ☐ 10 700 |



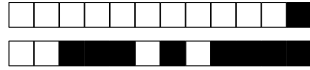
Question 13

7 jobs must be executed on a machine M_1 then on a machine M_2 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7
M_1	130	200	80	40	20	110	150
M_2	230	50	50	60	80	150	270

Check the order that could be returned by the Johnson algorithm.

- | | | | | |
|----------------------|----------------------|----------------------|----------------------|-----------------------|
| <div>1</div> 3174562 | <div>3</div> 3521467 | <div>5</div> 4276351 | <div>7</div> 5427316 | <div>9</div> 1452376 |
| <div>2</div> 2467531 | <div>4</div> 3712456 | <div>6</div> 5461723 | <div>8</div> 5473126 | <div>10</div> 5136427 |

**Question 14**

6 jobs must be executed on a machine M_1 then on a machine M_2 and finally on a machine M_3 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . Similarly for M_3 . The durations of the jobs on the three machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6
M_1	100	140	210	200	60	70
M_2	50	10	60	20	20	60
M_3	120	130	110	80	80	170

Parmi les ordres suivants, lequel correspond à un résultat que pourrait renvoyer l'algorithme de Johnson adapté au cas de 3 machines? Si cet algorithme n'est pas adapté au cas de 3 machines, cochez la case "Err".

Check the order that could be returned by the Johnson algorithm, if this algorithm is suitable for this case. Otherwise, check "Err".

- | | | | | |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|
| ☐ 1 Err | ☐ 3 561324 | ☐ 5 621354 | ☐ 7 135264 | ☐ 9 654312 |
| ☐ 2 136452 | ☐ 4 452631 | ☐ 6 314256 | ☐ 8 452361 | ☐ 10 624513 |



Question 15

8 jobs must be executed on a machine M_1 then on a machine M_2 , in **any** order. A job can be executed on one machine at a time, and a machine can execute only one job at the same time. The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7	j_8
M_1	80	20	20	290	70	60	10	110
M_2	210	290	200	220	140	200	90	280

What is the minimum time we need to execute all the jobs on the machines?

- | | | | | |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| ☐ 1 1440 | ☐ 3 1670 | ☐ 5 510 | ☐ 7 1290 | ☐ 9 1060 |
| ☐ 2 1630 | ☐ 4 470 | ☐ 6 1580 | ☐ 8 1300 | ☐ 10 660 |



Question 16

5 jobs must be executed on a machine M_1 then on a machine M_2 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5
M_1	80	80	130	80	30
M_2	100	160	140	160	60

Check the order that could be returned by the Johnson algorithm.

- | | | | | |
|--------------------|--------------------|--------------------|--------------------|---------------------|
| <div>1</div> 12543 | <div>3</div> 15423 | <div>5</div> 34251 | <div>7</div> 51423 | <div>9</div> 32451 |
| <div>2</div> 14523 | <div>4</div> 23145 | <div>6</div> 51243 | <div>8</div> 42531 | <div>10</div> 14253 |



Question 17

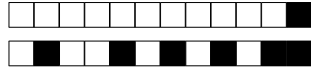
6 jobs must be executed on a machine M_1 then on a machine M_2 and finally on a machine M_3 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . Similarly for M_3 . The durations of the jobs on the three machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6
M_1	150	230	160	180	110	220
M_2	30	10	20	70	60	70
M_3	240	170	140	90	70	240

Parmi les ordres suivants, lequel correspond à un résultat que pourrait renvoyer l'algorithme de Johnson adapté au cas de 3 machines? Si cet algorithme n'est pas adapté au cas de 3 machines, cochez la case "Err".

Check the order that could be returned by the Johnson algorithm, if this algorithm is suitable for this case. Otherwise, check "Err".

- | | | | | |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|
| ☐ 1 Err | ☐ 3 154263 | ☐ 5 162345 | ☐ 7 634152 | ☐ 9 163254 |
| ☐ 2 134562 | ☐ 4 532146 | ☐ 6 514263 | ☐ 8 632145 | ☐ 10 263514 |



Question 18

7 jobs must be executed on a machine M_1 then on a machine M_2 , in **any** order. A job can be executed on one machine at a time, and a machine can execute only one job at the same time. The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7
M_1	230	120	160	150	100	170	180
M_2	200	80	160	120	180	260	280

What is the minimum time we need to execute all the jobs on the machines?

- | | | | | |
|--------------------------------|--------------------------------|---------------------------------|--------------------------------|----------------------------------|
| ☐ 1 530 | ☐ 3 700 | ☐ 5 1280 | ☐ 7 610 | ☐ 9 1240 |
| ☐ 2 800 | ☐ 4 460 | ☐ 6 1110 | ☐ 8 730 | ☐ 10 1060 |



Question 19

5 jobs must be executed on a machine M_1 then on a machine M_2 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5
M_1	10	200	10	100	90
M_2	180	150	50	190	70

Check the order that could be returned by the Johnson algorithm.

- | | | | | |
|--------------------|--------------------|--------------------|--------------------|---------------------|
| <div>1</div> 51423 | <div>3</div> 13425 | <div>5</div> 41253 | <div>7</div> 35412 | <div>9</div> 52413 |
| <div>2</div> 54123 | <div>4</div> 12345 | <div>6</div> 34215 | <div>8</div> 21534 | <div>10</div> 45321 |

**Question 20**

5 jobs must be executed on a machine M_1 then on a machine M_2 and finally on a machine M_3 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . Similarly for M_3 . The durations of the jobs on the three machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5
M_1	90	50	140	50	80
M_2	10	40	20	10	50
M_3	50	100	190	160	170

Parmi les ordres suivants, lequel correspond à un résultat que pourrait renvoyer l'algorithme de Johnson adapté au cas de 3 machines? Si cet algorithme n'est pas adapté au cas de 3 machines, cochez la case "Err".

Check the order that could be returned by the Johnson algorithm, if this algorithm is suitable for this case. Otherwise, check "Err".

- | | | | | |
|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|
| ☐ 1 Err | ☐ 3 41523 | ☐ 5 31425 | ☐ 7 25413 | ☐ 9 21354 |
| ☐ 2 34521 | ☐ 4 25143 | ☐ 6 32415 | ☐ 8 42531 | ☐ 10 12543 |



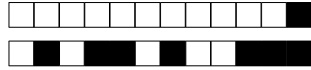
Question 21

7 jobs must be executed on a machine M_1 then on a machine M_2 , in **any** order. A job can be executed on one machine at a time, and a machine can execute only one job at the same time. The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7
M_1	250	140	210	40	140	30	210
M_2	80	280	10	250	230	130	160

What is the minimum time we need to execute all the jobs on the machines?

- | | | | | | | | | | |
|----------------------------|------|----------------------------|------|----------------------------|------|----------------------------|------|-----------------------------|------|
| ☐ 1 | 790 | ☐ 3 | 420 | ☐ 5 | 1090 | ☐ 7 | 1200 | ☐ 9 | 1140 |
| ☐ 2 | 1210 | ☐ 4 | 1000 | ☐ 6 | 1020 | ☐ 8 | 330 | ☐ 10 | 670 |



Question 22

5 jobs must be executed on a machine M_1 then on a machine M_2 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5
M_1	50	180	110	140	160
M_2	130	130	50	130	180

Check the order that could be returned by the Johnson algorithm.

- | | | | | |
|--------------------|--------------------|--------------------|--------------------|---------------------|
| <div>1</div> 54321 | <div>3</div> 24315 | <div>5</div> 43152 | <div>7</div> 42153 | <div>9</div> 15432 |
| <div>2</div> 52134 | <div>4</div> 32541 | <div>6</div> 54231 | <div>8</div> 15243 | <div>10</div> 45312 |

**Question 23**

8 jobs must be executed on a machine M_1 then on a machine M_2 and finally on a machine M_3 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . Similarly for M_3 . The durations of the jobs on the three machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7	j_8
M_1	170	290	120	150	210	320	300	290
M_2	80	80	10	80	80	80	50	30
M_3	190	320	240	80	270	200	150	260

Parmi les ordres suivants, lequel correspond à un résultat que pourrait renvoyer l'algorithme de Johnson adapté au cas de 3 machines? Si cet algorithme n'est pas adapté au cas de 3 machines, cochez la case "Err".

Check the order that could be returned by the Johnson algorithm, if this algorithm is suitable for this case. Otherwise, check "Err".

- | | | | | |
|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|
| ☐ 1 Err | ☐ 3 23518746 | ☐ 5 31528674 | ☐ 7 18437625 | ☐ 9 38476521 |
| ☐ 2 67514823 | ☐ 4 12786435 | ☐ 6 18473652 | ☐ 8 75823164 | ☐ 10 64735218 |



Question 24

8 jobs must be executed on a machine M_1 then on a machine M_2 , in **any** order. A job can be executed on one machine at a time, and a machine can execute only one job at the same time. The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7	j_8
M_1	40	160	250	70	270	280	110	230
M_2	80	250	50	280	300	100	320	140

What is the minimum time we need to execute all the jobs on the machines?

- | | | | | | | | | | |
|----------------------------|------|----------------------------|------|----------------------------|------|----------------------------|-----|-----------------------------|------|
| ☐ 1 | 1350 | ☐ 3 | 1180 | ☐ 5 | 1410 | ☐ 7 | 870 | ☐ 9 | 570 |
| ☐ 2 | 1150 | ☐ 4 | 1490 | ☐ 6 | 1380 | ☐ 8 | 790 | ☐ 10 | 1520 |



Question 25

7 jobs must be executed on a machine M_1 then on a machine M_2 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7
M_1	60	40	50	110	170	210	50
M_2	240	200	130	60	60	60	250

Check the order that could be returned by the Johnson algorithm.

- | | | | | |
|----------------------|----------------------|----------------------|----------------------|-----------------------|
| <div>1</div> 1347526 | <div>3</div> 7146532 | <div>5</div> 2371456 | <div>7</div> 4625713 | <div>9</div> 2645713 |
| <div>2</div> 6417253 | <div>4</div> 2364517 | <div>6</div> 6351427 | <div>8</div> 5317426 | <div>10</div> 4315627 |



Question 26

5 jobs must be executed on a machine M_1 then on a machine M_2 and finally on a machine M_3 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . Similarly for M_3 . The durations of the jobs on the three machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5
M_1	70	80	100	130	70
M_2	50	40	30	30	30
M_3	100	130	130	60	50

Parmi les ordres suivants, lequel correspond à un résultat que pourrait renvoyer l'algorithme de Johnson adapté au cas de 3 machines? Si cet algorithme n'est pas adapté au cas de 3 machines, cochez la case "Err".

Check the order that could be returned by the Johnson algorithm, if this algorithm is suitable for this case. Otherwise, check "Err".

- | | | | | |
|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|
| ☐ 1 Err | ☐ 3 43521 | ☐ 5 12345 | ☐ 7 42135 | ☐ 9 42513 |
| ☐ 2 35412 | ☐ 4 52143 | ☐ 6 51432 | ☐ 8 45213 | ☐ 10 32451 |



Question 27

7 jobs must be executed on a machine M_1 then on a machine M_2 , in **any** order. A job can be executed on one machine at a time, and a machine can execute only one job at the same time. The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7
M_1	160	140	190	170	1070	130	240
M_2	280	40	10	120	790	140	180

What is the minimum time we need to execute all the jobs on the machines?

- | | | | | |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|
| ☐ 1 1690 | ☐ 3 2180 | ☐ 5 1790 | ☐ 7 2100 | ☐ 9 1660 |
| ☐ 2 1560 | ☐ 4 1650 | ☐ 6 2090 | ☐ 8 1670 | ☐ 10 1860 |



Question 28

7 jobs must be executed on a machine M_1 then on a machine M_2 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7
M_1	230	20	180	230	220	50	90
M_2	240	150	100	70	180	140	270

Check the order that could be returned by the Johnson algorithm.

- | | | | | |
|----------------------|----------------------|----------------------|----------------------|-----------------------|
| <div>1</div> 4375216 | <div>3</div> 2435671 | <div>5</div> 7645132 | <div>7</div> 7231564 | <div>9</div> 2546173 |
| <div>2</div> 6247351 | <div>4</div> 4725613 | <div>6</div> 4521376 | <div>8</div> 6431725 | <div>10</div> 2671534 |

**Question 29**

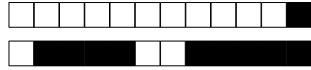
7 jobs must be executed on a machine M_1 then on a machine M_2 and finally on a machine M_3 , in that order. At the end of the execution of a job on M_1 , it can be executed on M_2 if the machine is available, otherwise, we wait for the availability to start the job on M_2 . Similarly for M_3 . The durations of the jobs on the three machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6	j_7
M_1	240	120	210	230	240	180	210
M_2	80	30	60	60	30	60	30
M_3	200	260	190	120	100	170	80

Parmi les ordres suivants, lequel correspond à un résultat que pourrait renvoyer l'algorithme de Johnson adapté au cas de 3 machines? Si cet algorithme n'est pas adapté au cas de 3 machines, cochez la case "Err".

Check the order that could be returned by the Johnson algorithm, if this algorithm is suitable for this case. Otherwise, check "Err".

- | | | | | |
|------------------------------------|------------------------------------|------------------------------------|------------------------------------|-------------------------------------|
| ☐ 1 Err | ☐ 3 3457621 | ☐ 5 5423617 | ☐ 7 4576213 | ☐ 9 3416572 |
| ☐ 2 2136457 | ☐ 4 3674152 | ☐ 6 3157246 | ☐ 8 7354162 | ☐ 10 1645732 |



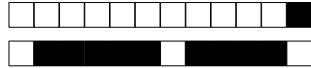
Question 30

6 jobs must be executed on a machine M_1 then on a machine M_2 , in **any** order. A job can be executed on one machine at a time, and a machine can execute only one job at the same time. The durations of the jobs on the two machines are given in the following table.

Duration $t(j, M)$	j_1	j_2	j_3	j_4	j_5	j_6
M_1	40	780	150	240	240	100
M_2	10	700	100	240	230	100

What is the minimum time we need to execute all the jobs on the machines?

- | | | | | |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|
| ☐ 1 1480 | ☐ 3 1640 | ☐ 5 1450 | ☐ 7 1340 | ☐ 9 1380 |
| ☐ 2 1370 | ☐ 4 1440 | ☐ 6 1490 | ☐ 8 1550 | ☐ 10 1600 |



Entraînement - Training

Noircissez complètement ci-dessous les 3 premières lettres de votre nom de famille et la première lettre de votre prénom. Par exemple, pour Jean Dupont, cochez J, D, U, P ; pour Henri Harley, cochez seulement H, A, R ; pour Bernard Ca, cochez seulement A, B, C.

Check entirely the 3 first letters of your lastname and the first letter of your firstname. For instance, for Jean Dupont, check J, D, U, P ; for Henri Harley, check only H, A, R ; for Bernard Ca, check only A, B, C.

A	B	C	D	E	F	G	H	I	J	K	L	M
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

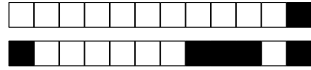
Then write your lastname and firstname below.

Nom et prénom :

.....

Les réponses aux questions sont à donner exclusivement sur cette feuille. Les réponses données sur les feuilles précédentes ne seront pas prises en compte. Pour cocher une case, il faut la **noircir complètement**. Vous pouvez effacer votre réponse à la gomme ou avec du blanc, attention à ne pas effacer la case à cocher. Si vous êtes dans l'impossibilité de corriger une erreur, cette page est dupliquée au verso ; vous pouvez alors barrer cette feuille ci et répondre au verso.

QUESTION 1 :	1	2	3	4	5	6	7	8	9	10
QUESTION 2 :	1	2	3	4	5	6	7	8	9	10
QUESTION 3 :	1	2	3	4	5	6	7	8	9	10
QUESTION 4 :	1	2	3	4	5	6	7	8	9	10
QUESTION 5 :	1	2	3	4	5	6	7	8	9	10
QUESTION 6 :	1	2	3	4	5	6	7	8	9	10
QUESTION 7 :	1	2	3	4	5	6	7	8	9	10
QUESTION 8 :	1	2	3	4	5	6	7	8	9	10
QUESTION 9 :	1	2	3	4	5	6	7	8	9	10
QUESTION 10 :	1	2	3	4	5	6	7	8	9	10
QUESTION 11 :	1	2	3	4	5	6	7	8	9	10
QUESTION 12 :	1	2	3	4	5	6	7	8	9	10
QUESTION 13 :	1	2	3	4	5	6	7	8	9	10



- QUESTION 14 :
- QUESTION 15 :
- QUESTION 16 :
- QUESTION 17 :
- QUESTION 18 :
- QUESTION 19 :
- QUESTION 20 :
- QUESTION 21 :
- QUESTION 22 :
- QUESTION 23 :
- QUESTION 24 :
- QUESTION 25 :
- QUESTION 26 :
- QUESTION 27 :
- QUESTION 28 :
- QUESTION 29 :
- QUESTION 30 :